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RESOLVING INADEQUACIES OF THE NAVY INDUSTRIAL FUND COST ACCOUNTING SYSTEM TO ENABLE ITS USE IN THE RAMP SMP FACILITY

by

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December 1988

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Previous research concluded that several elements of the NIF cost accounting system were inadequate for use in the RAMP facility. Inadequate areas included direct and indirect cost definitions, indirect cost allocations, and performance measures.

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Resolving Inadequacies of the Navy Industrial Fund Cost Accounting System to Enable its Use in the RAMP SMP Facility

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I. INTRODUCTION

A. BACKGROUND

The Navy is constructing an automated manufacturing plant which incorporates flexible manufacturing systems (FMS) and computer integrated manufacturing (CIM). The plant, which is known as the RAMP SMP facility, will be integrated into a naval shipyard organization. (Bryant, 1988)

All naval shipyards operate within the Navy Industrial Fund (NIF) system (NAVCOMPT-A, 1985). Since the facility will be an activity within a shipyard, RAMP SMP will also be included in the NIF system.

Traditionally, activities within the NIF system use labor intensive manufacturing processes. As a result, the NIF cost accounting system is designed to serve labor intensive processes. (NAVSEAINST 7600.27, 1984) Direct costs are assigned directly to the units produced, and indirect costs are generally allocated on a direct labor hour basis. The advent of FMS and CIM has resulted in capital intensive manufacturing processes. Technologically intensive, highly sophisticated computer controlled machines automatically produce parts and completed units. In FMS and CIM environments, direct labor input as a percentage of product cost, decreases substantially.

Incorporation of the RAMP SMP facility into the NIF system necessitated a review of NIF cost accounting practices. Previous research (Bryant, 1988) concluded that some elements of the NIF accounting system are inadequate in an automated manufacturing environment. Inadequate elements are:

- Definitions for Direct and Indirect Costs--automated manufacturing increases indirect cost pools and decreases direct costs. Calculated production costs may be unreliable due to inaccurate indirect cost definitions. Therefore, true production costs will be difficult to glean in the RAMP facility under current NIF practices.

- Allocation of Indirect Costs--NIF uses direct labor hours as the allocation base for indirect costs. This is inappropriate in an automated environment. In the RAMP SMP facility only minimal production costs will be attributable to direct labor.

- Performance Measurement--financial performance and productivity are the thrust of current NIF system performance measurements. In the FMS environment, to fully evaluate performance, different measurements should be developed. In particular, product quality and cost driver information should be identified and measured.

In this thesis, a model is developed and presented which identifies resolutions to NIF cost accounting inadequacies in an automated manufacturing environment. Information for model development is drawn from current cost accounting practices, and theoretical cost accounting principles in the commercial workplace.

A detailed description of RAMP SMP operations, and the development of NIF accounting inadequacies previously presented by Bryant (1988) is not repeated in this thesis.

B. THESIS OBJECTIVE

The purpose of this thesis is to identify resolutions to the inadequacies of the Navy Industrial Fund (NIF) cost accounting system to enable its use in the Navy's Rapid Acquisition of Manufactured Parts Small Manufactured Parts (RAMP SMP) facility.

The goals of this thesis are to answer the following questions:

- How should direct and indirect costs be redefined by the NIF cost accounting system for use in the RAMP SMP activity?
- What is the most appropriate allocation base for indirect costs in the RAMP SMP facility?
- How can NIF system performance measurement criteria be amended to include a measure of product quality and identification of cost drivers?

C. RESEARCH METHODOLOGY

Utilizing a normative approach, archival and analytic research are the principle methodologies used in this thesis. Archival research was used as a basis for developing a satisfactory cost accounting model for use in an FMS/CIM environment. Analytic research was used as a means for developing and tailoring the model to produce practical solutions to NIF accounting deficiencies within the framework of the RAMP SMP facility.

1. Archival Research

Archival research entailed a literature review of accounting periodicals, manufacturing journals, the Navy Comptroller Manual, and Computer Aided Manufacturing-International (CAM-I) documents. The purpose of the review was to collect the opinions and ideas of manufacturers, accountants, and government officials with regards to innovative cost accounting methods for use in an automated manufacturing environment. The ideas from these authoritative sources provided a pool of information from which a model solution to NIF accounting deficiencies could be developed.

2. Analytic Research

Analytic research was used to construct and analyze the model solution to NIF deficiencies.

D. THESIS ORGANIZATION

This thesis has four chapters. Chapter I is the introduction. It states the objective of this thesis, presents research questions, and discusses research methodologies used. In Chapter II, a model is developed and presented. The model identifies resolutions to cost accounting inadequacies in an automated manufacturing environment. Chapter III is an analysis of the developed model as it pertains to the RAMP SMP facility. Interpretation of the methods presented and the feasibility for adopting the methods and procedures into NIF for use in RAMP are discussed. Chapter IV, the concluding chapter, summarizes the research and makes recommendations.

II. DEVELOPMENT OF A COST ACCOUNTING MODEL FOR AN AUTOMATIC MANUFACTURING ENVIRONMENT

A. INTRODUCTION

The purpose of this chapter is to develop a model which presents resolutions to cost accounting deficiencies in an automated manufacturing environment.

B. BACKGROUND

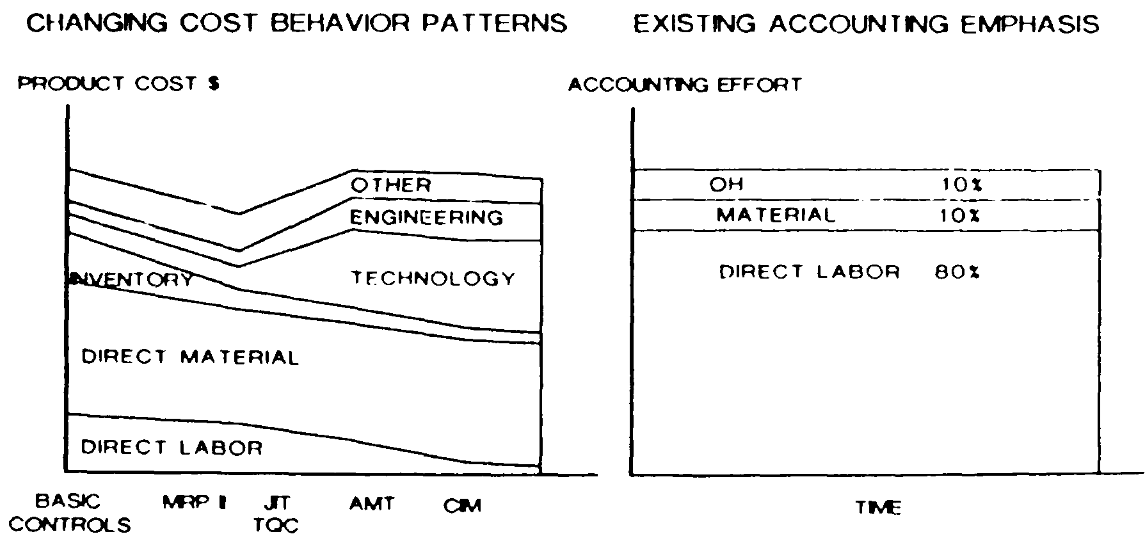
1. Cost Accounting Evolution

In the 1960's cost accounting systems were designed primarily for financial reporting; principally to value inventory (Grady, 1988). In order to determine the proper value that should be assigned to completed units of manufactured inventory, costs are normally accumulated in two pools: direct and indirect costs. Direct costs are those costs which contribute to and are directly traceable to a production or service output. Usually direct materials and direct labor comprise direct costs. Indirect costs are manufacturing or production costs which are incurred because of production activity, but are not directly traceable to a completed production or service output. Indirect costs are normally classified as production overhead costs and include such costs as supervision, maintenance, depreciation, rent, utilities, insurance, and taxes.

Historically, manufacturing activities have been labor intensive and man-paced. The common shop laborer operated one machine. Direct labor inputs represented the major percentage of product costs. If direct labor inputs were increased, product costs increased correspondingly. In most cases, direct labor was the cost driver which determined overhead. Cost drivers are "those activities and/or transactions that cause costs to arise or result in increased costs but do not necessarily add value." (Stasey, 1988) Since direct labor and product cost were positively correlated, overhead was generally allocated on a direct labor hour basis.

Old established cost systems do not give CIM managers the accurate and timely information they need to measure product costs and promote efficiencies (Kaplan, 1988). Modern CIM facilities use technology intensive, sophisticated computer controlled machines. Direct labor input as a percentage of product costs has decreased significantly as compared to labor intensive and man-paced environments. Today in many companies, direct labor comprises less than 10% of product costs; in some highly technical processes direct labor amounts to less than 5% of product cost (Grady, 1988). Also, in many cases when direct labor input is the allocation basis, the overhead allocation rate can exceed 1000%. In summary, manufacturing costs are no longer as reactive to changes in levels of direct labor (Frecka and McIlhattan, 1987).

Figure 2-1 graphically represents the change in product cost composition in a CIM environment.



Source: (McNair and Mosconi, 1988)

Figure 2-1 Changes in Production Cost Composition

The figure on the right depicts traditional labor intensive manufacturing. Direct labor constituted most of the product costs, while material and overhead costs were usually considered equal components, but significantly less than direct labor. The figure on the left illustrates the effect computer integrated manufacturing has had on changing cost behavior patterns. Reading to the far right along the horizontal axis, it can be seen that direct labor has become a less significant portion of total product cost in a CIM activity, while direct material is now a major contributor to product costs.

In the figure on the left, the overhead pool is represented by separate categories: engineering, technology, inventory maintenance, and other. The CIM overhead pool is significantly larger than the man-paced overhead pool. For instance, engineering and technology costs are increasing. State of the art machinery and computers have shortened life cycles and cost recovery periods. Newer generation fixed asset technology is quickly developed and produced which renders older equipment obsolete sooner. As a result, equipment must be replaced more frequently and depreciation is charged to overhead at a faster rate than had previously been experienced.

It is interesting to note that inventory maintenance costs are no longer a major cost component in CIM. Automated manufacturing tends to reduce inventory levels. This occurs because the producer has the flexibility to efficiently produce small quantity lot sizes, and in many cases produce products on demand while maintaining economies of scale.

Overall, Figure 2-1 illustrates the increase of the overhead pool and corresponding decrease of direct labor inputs in the automated manufacturing environment.

2. Cost Distortions in a CIM Activity

In an automated activity, managers that allocate indirect costs on the basis of direct labor inputs will distort product costs (Frecka and McIlhattan, 1987). As previously mentioned, automated manufacturing activities incur greater amounts of depreciation expenses more rapidly than a labor intensive activity because of increased fixed asset investment. However, current depreciation techniques assume that assets wear out at a uniform usage rate over time. Also, depreciation methods normally use a fixed time recovery period. The result of these assumptions is that value added to products is treated as if it is independent of the product and actual asset utilization during the recovery period. (Berliner and Brimson, 1988)

The following example illustrates how charging depreciation to overhead and then allocating the cost to products by a single plant-wide allocation base distorts product costs in a CIM activity. Although there are other more suitable methods for allocating indirect costs, this example, even though biased, is presented to emphasize the author's point.

Assume a manufacturer makes two products, product A through a labor intensive process and product B by a CIM process. Also assume the composite plant overhead allocation rate is based on the amount of direct labor dollars consumed. The computation for [illegible] overhead rate would resemble:

$$\text{Composite Overhead Rate} = \frac{\text{Total cost less total direct labor and direct material}}{\text{Total direct labor dollars}}$$

If a value-added approach for depreciation were used, the "true" cost for products A & B would be identical: - $925. A value-added approach assigns depreciation expense to the product based on its utilization of assets. In this example the direct technology line accounts for depreciation accumulation.

	Product A	Product B
Direct Labor	$200	$ 50
Direct Material	300	300
Direct Technology	50	200
Other Overhead	375	375
	$925	$925

The calculated single plant-wide overhead rate would be 400%, ((925+925-200-50-300-300)/250). A manufacturer that used traditional costing methods to allocate depreciation to units produced would charge depreciation to the overhead pool, then allocate the cost to their products. Product A's allocated overhead is $800 (400% * DL$), and product B's overhead allocation is $200 (400% * DL$). Overall, using a single allocation basis, product A costs $1300 and product B $550. This cost allocation results in a 40% error (($1300-$925)/$925).

	Product A	Product B
Direct Labor	$200	$ 50
Direct Material	300	300
Overhead	800	200
	$1300	$550

Source: (CAM-I, 1987)

Although technologically intensive product B actually generated the majority of the depreciation expense, it was only allocated a small fraction of the expense.

Manufacturers that cling to traditional product costing methods in a machine-paced environment will make poor management decisions for such choices as make or buy, pricing, competitive bidding, and external reporting. For example, in 1984 a Fortune 500 company implemented automated manufacturing techniques in one of its divisions. The company justified its decision on the expectation of decreasing total product costs by $2 million annually. The division overhead rate was set at 500% of direct labor, and 60% of overhead was considered variable. The implementation of manufacturing automation reduced direct labor costs by $500,000. Therefore, management expected a drop in overhead by $1.5 million. Unfortunately, during the first year, overhead costs were reduced by $250,000, only 17% of the expected savings. Management rationalized that their inability to achieve cost reductions in the first year was a result of increased start-up costs. Nevertheless, management felt confident with their estimates and continued with the project. The division never achieved their projected cost savings. The composite overhead rate increased and profit margins shrunk. Their failure was attributed to using direct labor inputs as a basis for allocating production overhead. (Grady, 1988)

These examples illustrate the cost distortions that occur when indirect costs are allocated using a direct labor hour or direct labor dollar basis in an automated environment. Moreover, it is clear that this accounting approach results in poor management decisions.

There are other problems in using direct labor hours or direct labor dollars as an allocation basis for overhead in an automated manufacturing environment. Traceability of cost information for management reporting objectives is hampered using traditional cost accounting methods. Assuming overhead variance calculations are not computed, costs that are accumulated in the overhead pool are not traced with any degree of intensity and cost reduction is not encouraged (Keegan, 1988). Therefore, as direct labor costs are shrinking and overhead pools are expanding, a larger percentage of the product's costs may not be adequately tracked. In particular, non-value added activities may not be located and their proliferation abated. A non-value added activity is any activity or procedure performed which does not directly add value to the product (McIlhattan, 1987). Examples of non-value added activities include:

- move time--the amount of time moving a product from one location to another.

- inspection time--the amount of time spent ensuring product quality, or spent reworking the product to a satisfactory quality level.

- wait time--the amount of time a product waits before it is processed, completed, shipped, or whatever.

- inventory storage time--the amount of time a product spends in storage before final processing or shipment.

- process time--the amount of time a product is worked on. (McIlhattan, 1987)

When product costs are distorted in the machine-paced activity, it is difficult to measure workcenter, managerial, and company performance. Also, strategic planning and economic decision making is tenuous which may result in a short lived company. The next section discusses alternative accounting methods for improving cost accounting in an automated manufacturing environment.

C. REDEFINING INDIRECT AND DIRECT COSTS AND COST CENTERS

Automated manufacturers are recognizing the changing cost behavior patterns of their products, and are revising accounting methods for defining and allocating indirect product costs.

1. Redefining Indirect and Direct Costs

Classification of production costs as direct or indirect lies with the manufacturer, and is dependent on the availability, accuracy, and economies of data collection. The integration of computers into the manufacturing process and the explosion of information technology has made information collection and reporting easier than previously experienced in the man-paced environment. Local area networks (LAN) and automated parts tracking system (AS/RS) make shop floor information readily available and cost breakdown information possible on a real time basis. (CAM-I, 1987) Computers can record "what, when, and how much was produced." (Kaplan, 1988) Also, as future generations of improved LAN technology are developed, the complexity and cost should decrease, while reliability increases (Berliner and Brimson, 1988).

Because of cost distortions, there is increased desire to identify indirect costs with specific processes and products. With improved cost tracking capabilities, Allen Seed has recommended that "direct costs be defined as costs that can be assigned directly to a cost center or product irrespective of its behavioral characteristic. Indirect costs are defined as costs which must be allocated to cost centers or products." (Seed, 1984) McIlhattan, utilizing Seed's definition, redefined certain costs as direct, which in a man-paced environment had been indirect. Table 2-1 summarizes costs and their proposed classifications.

2. <u>Redefining Cost Centers</u>

In addition to reclassifying costs, the automated manufacturer should review, and if necessary, restructure

TABLE 2-1

COST CLASSIFICATIONS

	Man-Paced Environment	Machine Environment
Operating Supplies	Indirect	Direct
Supervision	Indirect	Direct
Production Support Services	Indirect	Largely Indirect
Building Occupancy	Indirect	Indirect
Insurance and Taxes	Indirect	Indirect
Depreciation	Indirect	Direct
Direct labor	Direct	Direct
Material Handling	Indirect	Direct
Repairs and Maintenance	Direct	*Direct
Energy	Indirect	Direct

*It is realized that repair and maintenance in the man-paced environment, identified as a direct cost by McIlhattan, is usually an indirect cost. Table 2-1 is useful in illustrating that many previously indirect costs can now be classified as direct costs.

Source: (McIlhattan, 1987)

cost centers. Cost centers are unique to each organization, however, they should all be sufficiently detailed to:

- directly assign costs to the desired management reporting objectives.
- capture and report significant cost elements at the level at which they can be controlled.
- accumulate homogeneous costs in cost pools for allocation to a reporting objective. (CAM-I, 1987)

Reviewing and altering cost centers, and disaggregation of the overhead pool, has the potential to improve direct traceability of product costs to the cost objective and eliminate the old practice of a single plant-wide overhead allocation base. (CAM-I, 1987)

When defining cost centers, CAM-I recommends the following guidelines be used:

- Segregate different processes--Direct manufacturing processes should be segregated into different cost centers. For example, machine operations should not be combined with assembly operations.

- Base cost centers on group technology (GT)--When a process contains a cell with related equipment that can be thought of as a complex single machine, then it may be appropriate to treat the cell as a single cost center. Typically, the machines in the cell are functionally dissimilar (e.g., lathes, drills, material handling) but process a part as a total system.

- Aggregate families of similar machines--When a manufacturing process is performed on a similar type of machine that has similar capabilities and costs, then the entire family of machines can be treated as a single cost center.

- Isolate individual machines--When significant differences exist between machines in a manufacturing process, either in terms of capabilities or cost behavior patterns, then each machine should be treated as a separate cost center (for example, conventional machining versus numerical controlled machining).

- Establish multiple overhead rates--A single overhead rate is appropriate if the facility produces a single product or if it produces multiple products which each receive the same level of effort. Multiple overhead rates are needed to reflect different cost behavior patterns, routing variations, and volume patterns.

- Consider the volume of parts produced--The relative volume of parts flowing through a cost center can affect the accuracy of allocations significantly. In situations where both high- and low-volume parts are processed in an area, assigning overhead with a single rate can result in the high-volume parts subsidizing the low-volume parts. (CAM-I, 1987)

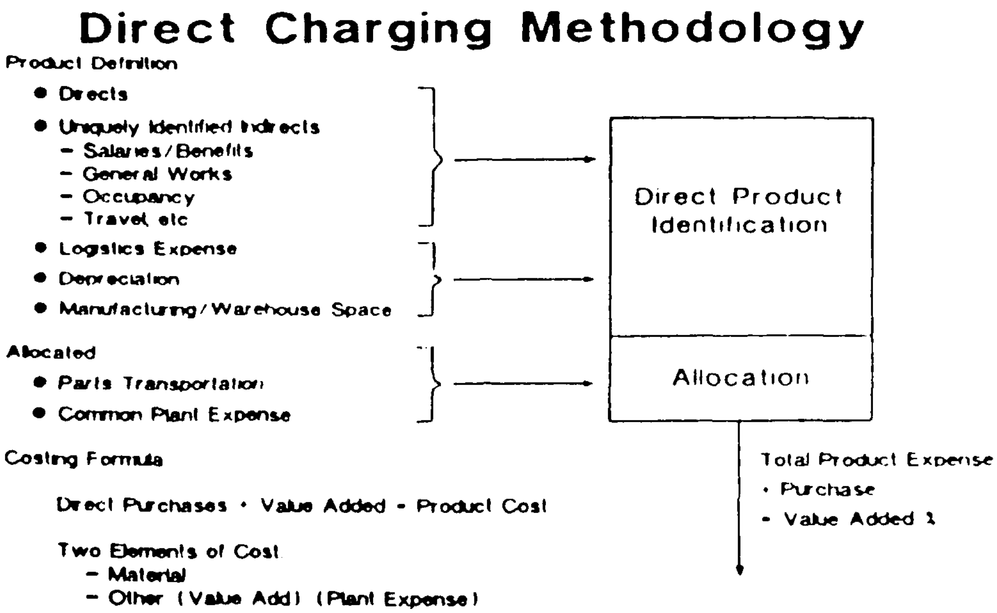
Changing the meanings of direct and indirect costs, and restructuring cost centers reduces cost allocations and improves cost traceability. However, making definitional changes is not enough to correct cost distortions. Other techniques, such as altering indirect cost allocation bases, also improve product costing (Berliner and Brimson, 1988).

D. INDIRECT COST ALLOCATION BASES

Normally, in a CIM environment, the direct labor allocation base for indirect costs must be revised. The production process is more sophisticated. Direct labor input has decreased significantly. Direct labor no longer provides a strong cause and effect relationship with the cost objective. (Berliner and Brimson, 1988)

1. Direct Charging Method

Regardless of the allocation base or bases selected, the bases should reflect cost drivers, maximize direct cost assignment, and minimize indirect cost allocation (Cooper and Kaplan, 1988). McNair and Mosconi recommend a direct charging method for costing products. The goal of this method is to disaggregate, as far as practical, the overhead pool by tracing overhead costs to specific products. Also, they argue direct charging will expose inefficient and ineffective activities which can ultimately be eliminated. This method, it is argued, will enable managers to control and reduce costs, to match costs and revenues by product, and to value inventory. (McNair and Mosconi, 1988) Figure 2-2 depicts the direct charging methodology presented by McNair and Mosconi.



Source: (McNair and Mosconi, 1988)

Figure 2-2 Direct Charging Methodology

Expense categories are identified which include direct (e.g., direct labor and direct material) and indirect costs (e.g., depreciation and logistics expense). McNair's and Mosconi's system assumes the existence of local area networks to facilitate cost driver tracking through cost centers. Costs previously defined as indirect such as depreciation, warehouse space, and salaries are now traced and assigned directly to specific cost centers and products. Also, many support service costs attributable to the manufacturing process, such as maintenance and production scheduling, are now charged to cost centers as they are received. For example, instead of allocating maintenance costs to all cost centers on a machine hour basis, maintenance costs would be charged to the user centers as they received the service. Detailed routing facilitates the direct charging approach. If a product travels through a series of predefined steps, cost collection should be simpler (Holbrook, 1988). The increased scrutiny of expenses facilitates targeting of inefficient and ineffective activities for elimination.

2. Indirect Cost Allocation

Although minimized by direct charging, indirect cost allocations continue in an automated manufacturing environment. The new task is developing and implementing an appropriate base for allocating indirect costs.

In order to select appropriate bases, cost drivers must be recognized and understood. As previously mentioned, cost drivers are "those activities and/or transactions that cause costs to arise or result in increased costs but do not necessarily add value." (Stasey, 1988) According to Cooper, there are no simple rules for selecting cost drivers. He argues the best approach is to identify the resource that makes up a significant portion of the product cost and determine its cost behavior. The driver's cost behavior must be similar to the cost being traced. (Cooper, 1987)

For example, assume an activity produces one labor intensive product (A) and 150 products by automation requiring frequent set-ups. Also, assume the activity uses direct labor hours as its plant wide indirect cost allocation base instead of multiple allocation bases. When the plant allocates set-up costs, product (A) would receive a disproportionate share of set-up costs. This occurs because the manufacturer did not recognize the appropriate cost drivers. In this example, set-up costs are driven by the complexity of the manufacturing process, not the volume of direct labor inputs.

Examples of cost drivers are:

- average number of engineering change orders per month.
- set-up hours.
- number of set-ups.
- material handling hours.
- number of times handled.
- ordering hours.
- number of times ordered.
- part number administration hours.
- number of part numbers maintained. (Cooper, 1988)

When cost drivers are determined, effective allocation bases can be developed. Single plant wide indirect cost allocation bases are growing extinct in the manufacturing environment. Multiple allocation bases are common; however, the number of allocation bases depends on the production process and diversity of the products manufactured. Allocation bases can be identical to cost drivers, but not always.

Possible allocation bases include:

- Direct labor hours or dollars.
- Machine hours.
- Throughput.
- Transactions handled.
- Number of set-ups.
- Distance traveled.
- Square footage.
- Material dollars.
- Number of employees.
- Total time in FMS.
- Units of Production. (CAM-I, 1987)

The most common bases and their advantages and disadvantages are outlined in Table 2-2.

Cost drivers should be continuously monitored and targeted for improvement and elimination (Stasey, 1988). If causal or beneficial relations change among cost centers and activities with regard to the reporting objectives, it is important their allocation bases change. (Berlinger and Brimson, 1988)

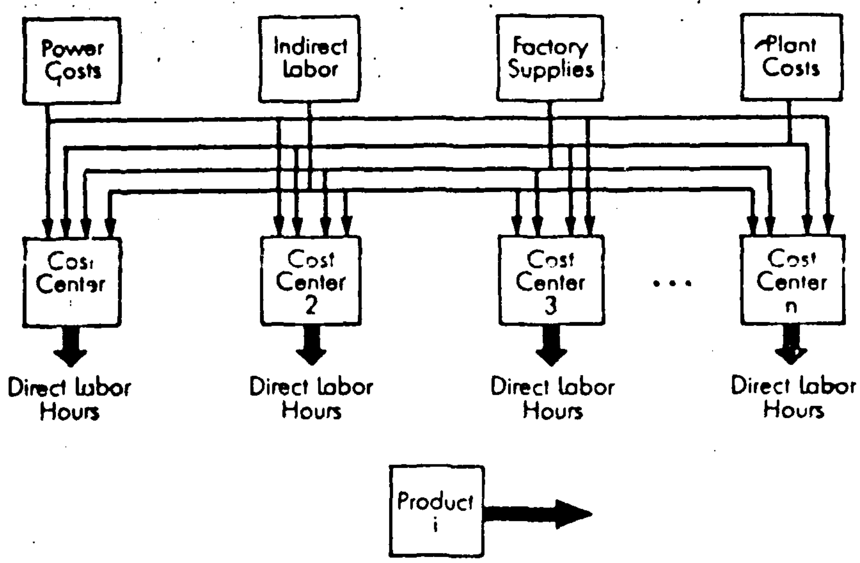
TABLE 2-2

ALLOCATION BASES ADVANTAGES AND DISADVANTAGES

Overhead Base	Advantages	Disadvantages
Units of Production	Simplicity; ease of use if homogeneous products produced	Parts not homogeneous require different operations
Total time in FMS	Reflects productive capacity of entire FMS	Difficult to measure and record
Engineered Machine Hours	Reflects machine time that should be used; readily available	Does not represent actual machine time
Actual Machine Hours	Measures use of productive capacity of machine tools; can be recorded by machine computer or FMS central computer	Includes inefficiencies in operation of machine tools

Source: (Bennett et al., 1987)

Costs can be allocated to the product using the two step allocation process discussed by Cooper and Kaplan. Figure 2-3 illustrates the two step process. In the first stage, resource costs are accumulated in cost pools. A suitable base which accurately reflects the cost driver is used to allocate indirect costs to cost centers. In the second stage, cost centers allocate costs to products with the same or more appropriate allocation base. Permitting the second stage (cost centers) to choose their allocation



Source: (Cooper and Kaplan, 1988)

Figure 2-3 The Two-Stage Allocation Process

base should result in better cost allocations because they are more attuned to their own cost drivers.

E. PERFORMANCE MEASURES

1. Historical Measures

Performance measurement is an estimate of how well activities are being performed in relation to specific goals and objectives of an organization. The purposes of performance measures are to exert control on the production process, support continual production process improvement and eliminate wasteful non-value added activities (Berliner and Brimson, 1988).

Traditional performance measures in man-paced manufacturing are unsatisfactory in a CIM environment (Berliner and Brimson, 1988). Typical traditional measurements capture dollar-based financial data not operational performance. Current performance measures which emphasize production output and meeting strict budget figures results in performance which is contrary to CIM objectives. For example, in some man-paced activities where users of performance measurement reports are not sophisticated, stressing output and budget results in:

- the accumulation of large inventories in excess of current needs.
- emphasizing output at the expense of quality. Achieving output standards gives people the feeling they have "arrived."
- wasted management effort. Focusing on direct labor hours utilized is not an effective measure for CIM activities. CIM uses very little direct labor in its manufacturing processes. Direct labor accounts for 2% to 10% of total product costs in an automated facility. (McIlhattan, 1987)

2. <u>New Performance Measures</u>

a. General Measures

There is an axiom, "you get what you measure." In other words, departmental performance generally is geared toward achieving the performance measure to which the department will be compared. Optimizing departmental performance is often dysfunctional to overall organizational objectives. For example, a purchasing department may buy poor quality electronic components at a discounted price to achieve a favorable purchase price variance. However, the manufacturing department will probably have an unfavorable materials usage variance due to problems associated with the poor quality electronic components. (Howell and Soucy, 1988)

Performance measurement must be redefined in the CIM environment if it is going to be effective and meaningful. New performance measures should be consistent with the ultimate goals of management, and multi-dimensional including operational as well as financial measures (Howell et al., 1987). The measurements should have the consensus of accountants, manufacturing managers, and engineering personnel (Bennett et al., 1987). More capable management information systems should make new performance measurements relatively simple and easy to generate.

The first step in establishing performance measures is to identify organizational priorities and objectives. Examples of organizational objectives include: decreasing cost/productivity ratios and increasing quality, customer satisfaction, dependability, and flexibility. Flexibility is defined as a rapid and efficient response to production volume changes, new product introduction, and new technology introduction. (Hall, 1988)

Once priorities and objectives are defined, performance measures can be developed. Performance measurement systems may vary among activities, but the principles should remain similar. All systems should:

- be simple, quantifiable, easily understood, and highly visible. Measures should be visible and understandable at the lowest level of the organization in order to improve performance.

- use a systems approach. Measurements should be congruent with the overall objectives of the organization, and not place emphasis on individual department achievement. Measures should also be totally within the responsibility of the person/cell performing the activity. There should not be any overlap of responsibility with others.

- be established for significant activities.

- include operational and financial measures.

- be continually refined and updated. Performance measurement should be an evolutionary process. If measures are no longer relevant they should be abandoned, and more suitable measures selected.

- be timely. Systems should be fast and timely. Material usage variances available next month are not satisfactory. For some functions such as R&D department, daily or weekly reports are unnecessary. However, for the production department, where high volume activity occurs hourly, more timely reports are essential. (Berliner and Brimson, 1988)

b. Specific Measures

New possible performance measures include:

- quality, including percentage of defects and percentage of rework.

- machine and system utilization percentages.

- productivity of the FMS.

- actual versus planned throughput per unit of product.

- manufacturing flexibility.

- levels of work in progress, raw materials inventories, and finished goods inventory.

- return on investment.

- parts produced.

- hours of downtime.

- hours of machining per part. (Bennett et al., 1987)

These measures relate to attributes that are controllable and manageable. They represent financial and operating performance which focus on:

- long term profitability.

- high quality.

- low inventories.

- fixed asset utilization.

- throughput. (Howell et al., 1987)

In the CIM environment, management information systems can provide on a continual basis feedback on resource usage and product output. Simultaneously, statistical process control calculations can be made which can identify deviations in production performance. Ultimately these simplified, easy to understand measurements can provide managers timely information which can improve manufacturing performance and quality.

III. NIF COST ACCOUNTING SYSTEM RESOLUTIONS

A. INTRODUCTION

The purpose of this chapter is to adapt the model developed and presented in chapter two to the Navy Industrial Fund (NIF) cost accounting system. The goal of this chapter is to resolve deficiencies in the NIF cost accounting system to enable its use in the RAMP SMP facility.

B. BACKGROUND

The purpose of the NIF cost accounting system is to "provide meaningful information that will facilitate intelligent and efficient administration of an activity." (NAVCOMPT-B, undated)

NIF uses a standard double entry, accrual basis cost accounting system. Expenses and revenues are recognized in the period in which they were incurred and earned respectively, and production oriented expenses are charged to specific jobs by a job order system. Indirect costs are allocated on a direct labor hour basis. Also, NIF utilizes a full absorption costing method to value completed production in accordance with generally accepted accounting principles (GAAP). (NAVCOMPT-A, 1985)

C. COST CENTER SEGREGATION

NIF cost centers are established to manage people, money, material, machines, and operational methods (NAVCOMPT-B, undated). Cost centers are comprised of natural groupings of machines, methods, processes, or operations. They are separate entities for budgeting, accounting, and management purposes, and generally have single management responsibility. There are three types of NIF cost centers: direct cost centers, general cost centers, and service cost centers. Direct cost centers are those directly engaged in, and responsible for performing production oriented work. General cost centers are those engaged in support services to the entire activity. Service cost centers are those which perform services on an "intra-activity user charge basis." (NAVCOMPT-A, 1985)

The RAMP facility is a flexible manufacturing system (FMS) which incorporates computer integrated manufacturing processes. Although RAMP will be located and integrated into the Naval shipyard organization, it does not provide the same type of service as the Naval shipyard. RAMP fulfills a logistic requirement for the Naval Supply System Command (NAVSUP) by manufacturing repair parts for fleet units to fulfill requirements submitted to the Naval supply system. For example, assume a RAMP eligible part, requisitioned by a fleet unit from an inventory stock point, is unavailable in the Naval supply system or from the original manufacturer. In this instance RAMP will receive a manufacturing order for the part. The RAMP facility will manufacture and test the part, and ship it to the fleet unit through Naval supply system transportation channels. (AMRC-A, 1988)

RAMP is essentially an autonomous facility within the Naval shipyard organization. Its planning and estimating (P&E), and manufacturing processes will not overlap with normal shipyard operation. However, RAMP's operation will require administrative support from the shipyard for general and administrative (G&A) functions such as automated data processing (ADP), publics works, fire and security protection, industrial relations, supply support, and comptroller support which may include accounting and payroll. *(Hicks, 1988)*

If the system utilized to account for the costs of RAMP operations is going to provide "meaningful information" for "intelligent and efficient administration," the RAMP facility must be treated as a separate entity, established as a direct cost center, within the Naval shipyard organization. According to Bennett et al., "Logically an FMS should be a separate cost center with its own overhead application rate because the FMS is often a relatively self-contained manufacturing subentity that is segregated from other manufacturing processes." (Bennett et al., 1987)

As a segregated activity, RAMP will be able to assign costs to desired management reporting objectives, and capture significant cost elements at a controllable level. Moreover, establishing RAMP as a separate entity conforms to CAM-I guidelines for defining cost centers. In particular CAM-I recommended that:

- different processes should be segregated.
- cost centers should be based on group technology.
- families of similar machines should be aggregated.

RAMP will be administratively supported by general cost centers of the parent shipyard. If services received from the shipyard cannot be directly charged to RAMP jobs, RAMP should receive an "equitable" allocation of total shipyard G&A expense for further allocation to completed jobs within RAMP. The direct charging methodology and determination of equitable allocation bases are discussed in detail later in the chapter.

There are advantages in creating a separate cost center for RAMP. RAMP is an ambitious and capital intensive project. Operational and financial performance expectations are estimates without historical foundation. Accordingly, there is a degree of uncertainty of RAMP's performance and its affect on overall shipyard performance. As its own cost center, RAMP's performance will be more clearly discernable to management. Operational and financial measures of RAMP will be virtually undiluted by decisions and actions by other shipyard cost centers. As a result, the shipyard commander can glean the performance of his shipyard with RAMP's performance detached, yet observable.

Additionally, the RAMP facility in Charleston is a NAVSUP creation and function that happens to be located within the perimeter of a Naval shipyard. As a result, RAMP will be integrated into the shipyard organization. By creating a separate cost center, individuals concerned about traditional shipyard functions will be relieved that RAMP is not directly integrated into the industrial process of the shipyard. Conversely, while NAVSUP personnel can be better assured of the physical success of RAMP by operating in an industrial environment, they can also obtain financial operating data to better support future endeavors of like kind.

There are, however, some disadvantages in segregating RAMP. As a "quasi-productive" cost center, RAMP will probably adhere to some shipyard business practices, and abstain from other practices. For instance, RAMP should develop its own stabilized billing rate based on factors other than the stabilized manday rate (SMDR) currently used in the shipyard. Since RAMP will use little direct labor, a rate dependent on mandays is impractical. Varying business practices within the same shipyard will probably create a larger workload for an already heavily worked administrative staff. Shipyard administrative employees, responsible for supporting RAMP, will have to become equally familiar with RAMP operations as they are currently with normal shipyard operations.

The advantages of segregating RAMP from the remainder of the shipyard significantly outweighs the disadvantages. The isolation allows for better cost control within RAMP and improved visibility of RAMP's operational and financial performance. It also allows for the least impact on current shipyard operations.

D. DIRECT AND INDIRECT COST DEFINITIONS

The traditional definitions for direct and indirect costs were previously defined in Chapter II. Summarizing, direct costs have traditionally been costs which contribute to and are directly traceable to a production or service output. Indirect costs are manufacturing or production costs which are incurred because of production activity, but are not directly traceable to completed production or service output.

These definitions are sound in the man-paced environment. However, current cost accounting practices create the potential for the expansion of indirect cost pools in an automated facility. Therefore, definitions and cost classifications must be modified to improve product costing activities. Definitions and classifications depend on the organization and the capabilities of data collection. In this case RAMP can implement Seed's definitions:

> ...direct cost be defined as cost that can be assigned directly to a cost center or product irrespective of its behavioral characteristics. Indirect costs are defined as costs which must be allocated to cost centers or products. (Seed, 1984)

The difference between the traditional definitions and Seed's definitions are subtle but important. Seed's definitions reflect the reality of the automated manufacturing environment. The proliferation of information technology, which will be utilized in RAMP through a LAN, makes data collection and dissemination fast, reliable, and efficient. Costs which were previously too hard to track, and classified as indirect, will now be easily recorded and considered direct. Costs such as depreciation and operating supplies can now be traced to production outputs. Table 2-1 summarized new possible cost classifications.

Amending RAMP's definition for direct and indirect costs should not be construed as a schism from traditional cost accounting methods. It is intended as a practical and logical alternative created by automated manufacturing techniques and computerized information systems imbedded in RAMP. The effect of changing direct and indirect cost definitions for RAMP should have no impact on the overall operation of the NIF accounting system. The change will enable RAMP to classify more costs as direct, and enhance the traceability of costs to production outputs.

In summary, the definitional change assists RAMP with providing more meaningful and accurate product cost information which is the essence of any cost accounting system.

E. INDIRECT COST ALLOCATION BASES

The nature of indirect cost allocations should change in RAMP. Indirect cost allocations should be decreased, and the allocation base should change from direct labor hours to a more appropriate basis. This section discusses the direct charging methodology and suitable indirect cost allocation bases for RAMP.

1. Direct Charging Methodology

Before discussing the direct charging methodology, it is important to outline the capabilities of RAMP's LAN. The LAN will be integrated at the cell level. In addition to providing manufacturing engineering type information, it will record the type and amount of materials consumed in production, and when they were used. The network will record machine usage and document product throughput time and total time in the manufacturing system. It will record virtually all other information pertaining to the RAMP manufacturing except cost data. (Dubois, 1988A) As of this writing, cost data will be computed externally of RAMP's LAN and translated into cost and financial accounting information. How that information will be computed and translated has not been determined. However, the mechanism for computing cost data and recording accounting information should be integrated into RAMP's LAN and accessible at the manufacturing cell level. The design of RAMP's LAN, the specific design of an accounting information network, and the integration of the latter with the former is beyond the scope of this thesis. Future research should explore the design of an information system whicn combines the attributes of RAMP's current semi-developed LAN with the attributes of RAMP's accounting system. Examples of the types of information that RAMP's integrated LAN should have the capability of measuring and recording are:

- direct labor costs.
- direct material costs.
- planning and estimation costs.
- machinery and equipment repair and calibration costs.
- material handling labor costs.
- set-up costs.
- rework and scrap costs.
- inspection services costs.
- material yields.
- product throughput time.
- total time in the manufacturing system.
- machine utilization.
- supervision.
- utilities usage.
- consumable supplies usage.

These examples do not exhaust the possibilities for RAMP's LAN. Management information systems designers should work with RAMP's management and operators to develop a LAN which measures and records not only significant costs and transactions, but also records the cost drivers which relate to the generation of those costs and transactions.

It is anticipated that RAMP's LAN will facilitate the use of a direct charging methodology. The direct charging methodology discussed by McNair and Mosconi, and illustrated by Figure 2-2, would reduce the volume of indirect cost allocations in RAMP. The goal of direct charging is to disaggregate the overhead pool as far as practical and identify overhead expenses directly to specific products. With RAMP's LAN, costs previously defined as indirect can now be identified with specific manufactured products and be classified as direct costs. For example, the following list, though not exhaustive, describes costs that should be considered direct in RAMP.

- Direct labor.

- Direct materials.

- Machinery and equipment repair--this will be a direct cost assigned to RAMP by the shipyard for repair efforts received from the shipyard. However, the repair cost must then be allocated within RAMP.

- Machinery and equipment maintenance--this will be a direct cost assigned to RAMP by the shipyard for maintenance efforts received from the shipyard. However, the maintenance cost must then be allocated within RAMP.

- Machinery, equipment, and instrument calibration--this is the same as the two preceding illustrations. The shipyard will be able to directly charge RAMP for the calibration services they rendered to RAMP, but the cost must then be allocated within RAMP.

- Material handling labor--this is for material handling labor external to RAMP. For instance, due to the expected limited material storage capabilities of RAMP, there may be instances when RAMP will draw materials from the shipyard. The shipyard labor involved in handling this material can be directly charged to RAMP. Within RAMP the labor cost will generally be directly assigned to a particular RAMP job order.

- Inspection services--this entails quality control inspections for various levels of work.

- Consumable supplies usage.

- Utilities usage--this includes telephone, electricity, and water.

- Labor costs associated with software updates.

- ADP services.

- Planning and estimation.

- Disposal of excess plant property.

There are several advantages to the direct charging methodology. Direct charging makes more costs visible to management than had previously been possible. Many indirect costs, historically included in the indirect cost pool will be identified with specific products. Disaggregating the overhead pool should expose inefficient and ineffective activities, and provide management with substantiating evidence to support efforts to reduce or eliminate these activities.

The extent of direct charging is limited by the accessibility and capability of the LAN. The cost of the LAN and its software generally is proportional to its quality. Therefore a compromise will most likely be necessary in order to balance data collection capabilities with funding realities.

Overall, direct charging enables management to disaggregate the overhead pool and assign more costs directly to specific products. However, indirect cost allocations will continue in RAMP. The next section discusses methods for improving indirect cost allocations.

2. Indirect Cost Allocation Bases

The current NIF practice of allocating overhead costs to specific jobs on a direct labor hour basis is unsatisfactory in RAMP and must be changed. Different appropriate bases must be developed which more closely relate incurrence of indirect costs to specific cost drivers. Cost drivers have been defined as occurrences which create costs or provide a measure of the rate of cost incurrence. Therefore, RAMP management must determine resources used for, or the activities associated with a given event, that behave in the same manner as the cost being traced. For example, in some instances the complexity of the manufacturing process drives the cost of set-up.

As cost drivers are established, an appropriate allocation base should be selected. An allocation base can be the cost driver but it is not necessary. The allocation base must be flexible and represent the benefits received by the reporting objective. If causal or beneficial relations change with respect to the reporting objective, the allocation base should change. RAMP should not rely on a single plant wide indirect cost allocation base. If there are different cost drivers for different indirect cost pools, then multiple allocation bases should be used.

Possible allocation bases and their advantages and disadvantages were described in chapter two. Table 2-2 described the most common allocation bases in an automated manufacturing environment and is reproduced here as Table 3-1 for the reader's convenience.

TABLE 3-1

ALLOCATION BASES ADVANTAGES AND DISADVANTAGES

Overhead Base	Advantages	Disadvantages
Units of Production	Simplicity; ease of use if homogeneous products produced	Parts not homogeneous require different operations
Total time in FMS	Reflects productive capacity of entire FMS	Difficult to measure and record
Engineered Machine Hours	Reflects machine time that should be used; readily available	Does not represent actual machine time
Actual Machine Hours	Measures use of productive capacity of machine tools; can be recorded by machine computer or FMS central computer	Includes inefficiencies in operation of machine tools

Source: (Bennett et al., 1987)

a. Step One in the Two-Step Allocation Process

Indirect cost allocations from the shipyard to RAMP is the first step in the two step allocation process. Using current practices, RAMP would be allocated its share of shipyard indirect costs on a direct labor hour basis. Given RAMP uses very little direct labor in its manufacturing process, RAMP will probably receive less than its fair share of indirect costs, while shipyard cost centers will absorb more than their fair share. Examples of indirect costs which could be allocated from the shipyard to RAMP include, but are not limited to:

- shipyard commander's office costs.
- security protection.
- fire protection.
- comptroller functions.
- utilities (steam).
- pollution and hazardous waste disposal and clean-up.
- maintenance of grounds, streets, roads, and walks.

A more appropriate basis for allocating shipyard indirect costs to RAMP should be established. It is recommended that the shipyard use multiple allocation bases to allocate indirect costs. Some costs which share similar cost drivers should be allocated using the same base, while other costs, whose drivers differ, should be allocated using different bases. In RAMP's first year of operation it will be difficult determining equitable and practical allocation bases because of the lack of RAMP historical data. A model RAMP facility, known as RAMP Test Integration Facility (RTIF), will be in operation prior to RAMP's start-up. In addition to debugging the manufacturing process, it is expected that the RTIF will provide some accounting information which will aid in determining indirect cost allocation bases (Dubois, 1988B). I suggest for the first year only, the shipyard estimate RAMP's contribution to the overhead pools, then allocate costs to RAMP based on the expected incremental changes in the cost pools. This is neither scientific nor exact. However, in the absence of tangible operating information, there are not many options available. The corporate knowledge embedded in the shipyard hierarchy should have an understanding of historical indirect cost incurrence. It is expected that sound management analysis should provide a reasonable estimate of indirect costs generated by RAMP. Developing proxy allocation bases will enable RAMP to receive and apply indirect costs to its job orders during its first year of operation.

After RAMP's first year of operation more precise allocation bases can be established. In areas where work unit measures are calculated, the change in the work unit measure during RAMP's first year will provide information to identify reasonable allocation bases. Adjusting for start-up costs and learning curve effects in the shipyard offices providing support, and barring unusual circumstance, changes in the work unit measure should provide a base figure that could be related to events or direct cost activity in the RAMP facility in an attempt to identify cost driver relationships. In other areas where work unit measures are not recorded, appropriate allocation bases should be selected based upon logical or proven past relationships. For instance, in the case of indirect costs associated with steam generation for heat, building cubic footage would be a reasonable allocation base.

Allocation techniques can be refined with time and allocation bases changed as circumstances warrant. The point to emphasize is that the allocation bases should more closely reflect cost drivers, yet remain practical in application so indirect costs are fairly allocated to RAMP. The current system is sufficiently flexible that it should not be a burden on the shipyard to alter its allocation base from direct labor hours to those described.

b. Step Two in the Two-Step Allocation Process

The second step in the two step allocation process is the allocation of indirect costs within RAMP to specific completed jobs. However, indirect cost pools should be defined before prescribing the second step bases for allocating indirect costs to specific jobs completed within RAMP. Additionally, the precise classifications of direct and indirect costs and the identification of appropriate allocation bases is contingent upon the capabilities of the LAN.

It is anticipated that the following indirect costs are representative of those which will be allocated within RAMP to specific parts produced:

- Equipment and machinery repair, maintenance, and calibration.
- Security protection.
- Fire protection.
- Pollution and hazardous waste disposal and clean-up.
- Maintenance of grounds. streets, roads, and walks.
- Shipyard commander's office costs.
- Comptroller functions.

For some types of indirect cost allocations, cost drivers are relatively obvious, and as a result a logical allocation base can be derived. For example, with equipment and machinery repair, maintenance, and calibration, machinery usage rate is a logical cost driver. Therefore, actual machine hours could be used as the allocation base. Actual machine hours is an accurate gauge of the machinery's usage. Moreover, recording machine hours is a simple task for RAMP's LAN.

There are other types of indirect costs whose cost drivers and resulting allocation bases are not so obvious. For instance, with Comptroller Department costs it is difficult discerning an appropriate cost driver and allocation base for specific jobs. The allocation base should resemble the cost driver. A more reasonable base for allocating Comptroller Department costs to specific jobs in RAMP is the total time a job spends in the flexible manufacturing system (FMS).

There are some indirect costs, such as security and fire protection, which require the accumulation of operational data before reasonable cost drivers and allocation bases can be identified. In the interim, proxy bases will have to be established for these indirect cost allocations. A possible initial allocation base for these indirect costs is total time in the FMS. It is conceivable that a part which remains in the FMS system longer has a greater probability of receiving more security and fire protection, however slight and indirect that may be.

The second step allocation base in RAMP should change from a direct labor hour base to more appropriate multiple bases which are continuously reviewed and updated as more historical data is accumulated. It can be observed that the same indirect cost can have different allocation bases in the first and second step of the allocation process. For example, in the first step allocation it was suggested that Comptroller Department costs be allocated based on the incremental change in the department's work unit measure (e.g., the number of accounting transactions handled for RAMP jobs) during RAMP's first year of operation. Yet, in the second step, it was suggested that

Comptroller Department costs be allocated to specific RAMP jobs based on the total time a job spends in the FMS. This is not inconsistent with appropriate allocation practices in an automated manufacturing environment. In the first step the incremental change in the work unit measure was a suitable and practical base between the shipyard and RAMP. However, in the second step allocation, the allocation base was changed to the more appropriate base of total time spent in the FMS. Management must recognize cost drivers of indirect cost pools at each step of the allocation process, and select allocation bases which reflect benefits received by the reporting objective. Overall, establishing more appropriate multiple indirect cost allocation bases results in better product costing and more accurate financial reporting.

F. PERFORMANCE MEASUREMENTS

Previous research, Bryant (1988), concluded that NIF performance measurements are incomplete for use in an automated manufacturing environment. While comparative analysis, trend analysis, breakeven analysis, ratio analysis, and variance analysis used in NIF are reasonable indicators of financial performance, there should be measurements which more directly reflect operational performance.

Additional operational performance measures should reflect RAMP's goals, particularly:

- reduced leadtime for manufactured parts. (NAVSUP, 1986)

- more efficient production. (NAVSUP,1986)

- reduced parts costs. (AMRC-A, 1988)

- quality manufacturing. (AMRC-A, 1988)

Measures should also emphasize the operational performance of the overall organization. The thrust of performance measurement is improving output and resolving production problems, not assessing blame and punishing employees. Moreover, performance measures should be timely, simple, quantifiable, and easily understood at the shop floor level where operational performance begins and ends.

Possible new performance measures should strike a balance between providing essential and useful information to users, and providing excessive and overwhelming information to users. The following operational performance measures are recommended additions to existing NIF performance measures.

- Actual throughput--throughput is defined as "the total volume of production through a facility." (Berliner and Brimson, 1988) This measure would provide an indication of RAMP's productivity.

- Machine utilization percentage--this measure would provide another indicator of RAMP's productivity, but it will also provide a measure of fixed asset utilization.

- Percentage of defects and rework--this measures manufacturing quality and efficiency.

- Total time in the system--this would measure the elapsed time from when RAMP received a manufacturing order until the part was completed and shipped. This provides an indication of improving or declining leadtimes.

In addition to computing and reporting the mentioned performance measures, RAMP should maintain an on-line statistical process control system. The system would selectively sample and evaluate manufacturing performance. The method does not determine whether performance is satisfactory, rather it determines whether performance is within tolerance. This control process provides floor level personnel a real time mechanism for monitoring manufacturing deviations and ensuring product quality.

These new measures are simple yet they help to capture the essence of RAMP's operational performance: reduced lead times, efficient production, and quality manufacturing. They emphasize the overall performance of RAMP, not any particular cell or workstation. The measures are also easily interpretable at the shop floor level and meaningful at management's level. RAMP's LAN should have the capabilities of collecting the information. Although actual throughput and the machine utilization percentage measures are generally not controllable by RAMP personnel, they are included as a means for recording and assessing RAMP's productivity. The percentage of defects and rework, and total time in the system are well within the responsibility and controllability of RAMP personnel.

The performance measures outlined in this section are general in nature and are suggested to create an awareness of possible measures. Detailed specification of RAMP performance measures is necessary. Future research is needed to determine the most appropriate and meaningful performance measures for implementation in the RAMP facility.

IV. CONCLUSIONS AND RECOMMENDATIONS

A. CONCLUSIONS

The purpose of this thesis was to identify resolutions to the inadequacies of the Navy Industrial Fund cost accounting system to enable its use in the Navy's RAMP SMP facility.

Chapter I discussed the advent of automated manufacturing and flexible manufacturing systems. Inadequacies of the NIF cost accounting system for use in the RAMP SMP facility were explained. Also, the thesis objective and research goals were presented. Lastly, the chapter detailed research methodologies which were to be used in the thesis.

In Chapter II a model was developed which presented resolutions to cost accounting deficiencies in an automated manufacturing environment. Historical information highlighted problems resulting from the application of existing cost accounting techniques in a flexible manufacturing system. Model development focused on redefining direct and indirect costs and cost centers, utilizing a direct charging methodology, developing appropriate multiple indirect cost allocation bases, and expanding performance measurement to include operational performance measures.

In Chapter III the model developed and presented in Chapter II was adapted to the NIF cost accounting system. The goal of the chapter was to resolve deficiencies in the NIF cost accounting system to enable its use in RAMP. In adapting the model to NIF, it was determined that changes to the NIF cost accounting system would be minimal yet essential. The areas requiring changes are direct and indirect cost definitions, indirect cost allocations, and performance measurement. NIF's cost center definition and determination is adequate. Establishing RAMP as a separate cost center is easily accomplished within NIF guidelines.

B. RECOMMENDATIONS

Underlying the development and analysis of resolutions to NIF cost accounting deficiencies is the assumption that RAMP's local area network (LAN) will be able to capture manufacturing information, such as product throughput time, and translate that information into useful cost data. The LAN should be capable of reporting information such as: direct material and labor costs, planning and estimation costs, machinery and equipment repair and calibration costs, material handling labor costs, set-up costs, rework and scrap costs, inspection services costs, material yields, product throughput time, total time in FMS, machine utilization, utilities usage, consumable supplies usage, and supervision. The capabilities of the LAN will determine RAMP's ability to use direct charging techniques and appropriate multiple indirect cost allocation bases. Further study is needed to determine a suitable design for an information system which will capture and provide the type of information discussed in Chapter III.

It is recommended that NIF abandon the direct labor hour base for indirect cost allocations to RAMP because it is no longer appropriate. With the expected decrease of direct labor inputs in RAMP, maintaining the base will result in an underallocation of indirect costs from the shipyard to RAMP resulting in product cost distortions. Multiple allocation bases which relate to cost drivers should be established for allocations from the shipyard to RAMP. Moreover, multiple allocation bases should be established for allocations within RAMP. As previously noted, first and second step allocation bases for the same indirect cost may be different because of varying cost drivers at the two levels of allocation. Suggestions for possible allocation bases, though not exhaustive, were outlined in Chapter III. Possible allocation bases included: actual machine hours, total time spent in the FMS, units of production, building cubic footage, and the incremental change in work unit measures.

Current performance measures for NIF activities are satisfactory, but not complete for measuring and assessing RAMP's performance. It is recommended that RAMP adopt additional measures which report operational performance such as actual throughput, machine utilization, percentage of defects and rework, and total time in the system. The measures outlined in chapter three are general in nature. Additional research is needed to determine the most appropriate and meaningful performance measures for implementation in the RAMP facility.

The changes recommended to the NIF cost accounting system are minimal yet essential. They appear to be achievable with little disruption to existing NIF practices. Without changes, the current NIF cost accounting system will fail to provide RAMP "meaningful information that will facilitate intelligent and efficient administration of an activity" which is the purpose of the NIF cost accounting system.

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